indefinitely, for the distribution of light and power appears to have taken the public by surprise, and has exercised a most depressing influence upon the holders of gas shares. Having given close attention to the question of electric lighting ever since 1867—when, following the researches of my brother, Dr. Werner Siemens, I presented a paper to the Royal Society describing the dynamo-electric principle—I may be allowed perhaps to make a few remarks upon the novelty and probable effect of Mr. Edison's startling announcement.

In passing an electric circuit from a main conductor into several or any number of branches, the current divides itself between those branches, according to the well-known law of Ohm, in the exact inverse ratio of the electrical resistance presented by each branch. A current may thus be divided, for instance, into ten separate currents of precisely equal force, if each branch is made to consist of a wire of the same length and conductivity; but if one of these wires was again to be slit into ten wires, presenting in the aggregate the same conductivity, each of these wires would only convey 100th part of the total current. In the same way one of the minor wires might again be subdivided into branches, each of which would convey an amount of electric current which would be accurately expressed by the relative resistance of the branch in question, divided by the total resistance of all the branches put together. It would thus seem that nothing could be more easy than to divide a powerful electric current among as many branches of varying relative importance as might be desired; but in the case of electric lighting a difficulty arises in consequence of the varying resistance of each electric light or candle, due to the necessarily somewhat varying distance of the carbon points from each other, upon which the length of the luminous arc depends. In order to work a number of lights upon different branches of the same current, it is necessary to furnish each branch with a regulator so contrived that an increase of current corresponding to too near an approach of the carbon points will produce automatically an increased resistance in that branch circuit, whereas an accidental increase in the distance between the carbon points of any lamp will cause the regulator to reduce the extraneous resistance of the circuit to a *minimum*. Such a mode of regulating currents was present in my mind when, in addressing the Iron and Steel Institute in March, 1877, I ventured to express my conviction that natural forces, such as represented by large waterfalls, could be utilised for the production of motive power and electric light, in towns at a distance even of thirty miles from such source, by means of a large electric conductor. This suggestion gave rise to a good deal of discussion and criticism, especially in the United States; but I replied to some of these criticisms in delivering one of the Science Lectures at Glasgow in March last, having already referred to the matter in a discussion that was held before the Institution of Civil Engineers on January 29 last. Having in the meantime perfected the regulator, I showed it in operation at the *soirée* of the Royal Society on June 19, and have only been waiting to get experimental data complete in order to bring the whole subject before one of the scientific bodies. The arrangement may be said to consist simply of a thin strip of copper or silver, say six inches long and half an inch broad, stretched horizontally between two supports with a weight or spring exerting a certain pressure in the middle. The branch current to be regulated is passed through this strip of metal, which is thereby heated to a certain moderate extent, depending upon the amount of current passing, and upon the rate of radiation of the heat produced in the strip to surrounding objects. Suppose that when the normal condition of things obtains, the strip of metal is maintained at the temperature of, say, 100° Fahrenheit, and suppose that by an accidental approach of the carbons of a lamp the resistance of the circuit is suddenly decreased, an almost instantaneous increase of temperature of the thin strip will ensue, which will cause it to elongate slightly, and allow the weight resting in the middle to descend, which in its turn causes an increase in the resistance of a small rheostat, through which the branch current in question has to flow.

It will thus be seen that it is not so much the novelty of the announcement made by Mr. Edison as the manner in which it has been conveyed to us that has alarmed a portion of the British public, and I hold that such startling announcements as these should be deprecated, as being unworthy of science and mischievous to its true progress.

Although I am strongly of opinion that electricity will gradually replace gas in many of its most important applications as being both cheaper and more brilliant, I still hold the opinion, quoted by Mr. Northover in his letter to you of yesterday, that its application will be limited, at least during our generation, to such larger purposes as the lighting of our coasts, to naval and military signalling, to harbours, quays, warehouses, and public buildings, including perhaps picture galleries and drawing-rooms, where the objections to gas are already felt to the extent of banishing that means of lighting to the passages, offices, and bed-rooms. I am, however, of opinion that a revolution even to the extent indicated must be the work of time, and that while gas will undoubtedly in due course be supplanted by its more brilliant rival for the purposes just indicated, the consumption of gas will be maintained by the increasing area of application resulting from increase of towns, and by additional applications for cooking and for heating purposes, for which gas will supplant the use of solid fuel, and thus confer a new benefit upon mankind by doing away with the nuisance of smoke and ashes. If gas companies only rightly understood their interests they would themselves take up electric lighting for those purposes for which it has the decided preference, and at the same time promote the application of gas for heating, in doing which they would clearly increase their business as lighting companies, while benefiting the public by providing them with the very best sources of heat and light.

NOTES

AT the request of the Chemical Society Prof. Ad. Wurtz, of Paris, has accepted the office of Faraday lecturer for this year. The subject of his lecture is "La Constitution de la Matière à l'État gazeux." The lecture is to be delivered on Tuesday, November 12, in the Theatre of the Royal Institution, Albemarle Street. On the following day the Fellows of the Chemical Society propose entertaining Prof. Wurtz at a dinner to be held at Willis's Rooms.

THOSE interested in the progress of natural science at our old universities should take notice of the fact that, after considerable opposition of the "Board of Studies of the Natural Science School," the majority of that Board (chiefly by the aid of the examiners, who are London, and not Oxford, men) have carried a series of resolutions which provide that "candidates for honours in biology" may be examined in experimental physiology. The necessary encouragement to the study of this subject, viz., examination in it as an "honour subject" now existing, we may hope to see as the result some activity in the physiological laboratory of Magdalen College. Similarly we have to notice the recognition of the morphology and physiology of the vegetable kingdom as a necessary part of the study and examination of the Oxford student who is a candidate for "honours in biology." Botany was long resisted and sneered at in Oxford. External pressure has, however, reinstated botany in the Oxford school of natural science, and it rests with the examiners in future to maintain the study of this subject in the direction indicated by Sachs' admirable treatise on Botany published by the University press.

THE following changes are proposed to be made in the Council of the London Mathematical Society for the ensuing session:—Mr. C. W. Merrifield, F.R.S., to be president in the room of Lord Rayleigh, F.R.S., who is proposed for the office of vice-president in conjunction with Prof. Cayley, F.R.S.; Messrs. J. Hopkinson, F.R.S., and H. M. Taylor to be ordinary members of council in the room of Prof. Clerk Maxwell, F.R.S., and Mr. T. Cotterell. The valedictory presidential address will probably be delivered at the annual meeting (November 14).

THE new specimen of *Archæopteryx lithographicus* of Solenhofen, the discovery of which was announced some time back, has been purchased by Dr. Otto Folger, President of the Freie Deutsche Hochstift, for the sum of 35,000 marks (1,750*l.*), and

will no doubt be placed in the hands of some competent German palæontologist for description. It is said to be in several respects more perfect than the first, and hitherto unique, specimen in the British Museum, which has been the subject of the labours of Prof. Owen and Prof. Huxley on this most remarkable of extinct birds.

THE death is announced of M. Leymarie, Professor of Geology at Toulouse, and the author of the first geological map of France.

THE death, at the age of seventy, of Prof. William Monroe Davis, is announced as having taken place at Cleveland, Ohio, U.S., on July 21 last. When quite advanced in life Prof. Davis took up the study of astronomy, and has long been known as an original thinker and labourer in this field. After the resignation by Prof. Mitchell, as director of the Cincinnati Observatory, he was succeeded by Prof. Davis, who remained in charge for some considerable time. Of late years he has not been actively employed in any work, with the exception of the construction of a telescope, which has done excellent service in his hands.

THE Society of Arts announce that their opening meeting will be held on November 20, when the chairman's inaugural address will be delivered and the following medals presented :—The Albert Medal (gold), for "Distinguished Merit in Promoting Arts, Manufactures, or Commerce," to Sir William G. Armstrong, C.B., F.R.S., D.C.L. The council also announce that the following papers will be read :—On November 27, "The Land of Midian," by Capt. Burton; December 4, "The Electric Light," fully illustrated with experiments, by T. N. Shoolbred; December 11, "The Route to India, with especial Reference to the Euphrates Valley Railway," by Hyde Clarke; December 18, "Science Teaching in Elementary Schools," by Dr. Gladstone, F.R.S.; and the first course (six in number) of lectures by W. M. Williams on "The Manufacture of Mathematical Instruments."

A CORRESPONDENT makes the interesting suggestion that the microphone might be used to detect if insects have any audible means of communicating with each other, and if so, what is its nature in different classes of insects.

THE fourth annual conference of the Cryptogamic Society of Scotland was held in the Royal Botanic Garden, Edinburgh, on the 9th, 10th, and 11th inst., under the presidency of Prof. Balfour, and was a success in every way. The business meeting was held in the lecture-hall, and in addition to the president's address a number of papers were read relating to recent discoveries—both in species and in morphology—in cryptogamic botany. An excursion was made to the Penicuick woods, where about 170 species of fungi, including one or two new and several rare species, were noted. The public show was held in the winter garden and herbarium of the Royal Botanic Garden, and was visited by a great many people, who appeared to be much interested in the exhibition. A considerable number of hymenomycetes, &c., were arranged in classified order and named. Many distinguished botanists, both English and Scottish, attended the meeting, and were very hospitably entertained by the president and other members of the local committee. A notice of the scientific results of the conference will be given in the *Scottish Naturalist*. Next year's conference is to take place at Forres. Arrangements may be learnt from the secretary of the Society, Dr. Buchanan White, Perth.

MR. T. MUIR, M.A., of the High School, Glasgow, has forwarded to the London Mathematical Society a verification of Pervouchine's first result regarding the divisibility of $2^{2^{12}} + 1$ by $7 \cdot 2^{14} + 1$ (NATURE, vol. xviii. p. 104). The mode of verification will be understood from the following question and solution :—Is $11 \cdot 2^4 + 1$ a factor of any number of the form $2^m + 1$? $11 \cdot 2^4 + 1 = 2^7 + 2^5 + 2^4 + 1 = 10110001$ (radix 2). The question thus is—"Is there any number which when multiplied by 10110001 will produce a number of the form 1000...0001? Now knowing that the last digit of the multiplier and product is 1, we infer that the last digit of the multiplicand must be 1. Taking it as such and performing the multiplication we have—

```
.......1
10110001
--------
.....1
....1000
....1
....0
....1
```

whence, in order that the result of the addition may be of the form ....0001, we see that the second, third, fourth, and fifth digits of the multiplicand must be 0, 0, 0, 1 respectively. Prefixing these to the first digit and continuing the multiplication we have—

```
....10001
10110001
---------
....10001
....10001
....10001
..10001
---------
```

from which on addition we deduce other four digits of the multiplicand; and so on. When we have got in all twenty-two digits the figuring is as follows :—

```
1011100101000010100001
                10110001
------------------------
1011100101000010100001
1011100101000010100001
1011100101000010100001
1011100101000010100001
------------------------
```

and we find that addition then gives a product of the required form; and thus we have the result—

$2^{29} + 1$ is divisible by $11 \cdot 2^4 + 1$.

When there are few significant figures in the multiplier, as here, it will readily be seen that a very considerable lessening of labour is possible, that, in fact, the digits of the multiplicand can be written down at a steady pace without any auxiliary figuring at all. This is what was actually done in Mr. Muir's verification of Pervouchine's first case. With reference to the editorial query as to how the trial divisors came to be thought of Mr. Muir refers to the *Turin Transactions* for the present year, where there is a paper by M. E. Lucas, which almost entitles him to the merit of being a sharer in the discovery.

THE excavations made in Carniola under the direction of Herr von Hochstätter, on spots of palæontological and prehistoric interest, have hitherto been crowned with every success. The Kreuzberg Cave, near Laas, in the district of Zirknitz, proved to be an exceedingly interesting bear cave. The investigations made in this district, at St. Michael, near Adelsberg, and at Klenke, near Waatsch, have furnished undeniable proofs of the existence of prehistoric colonies and burial grounds at these places. Another interesting discovery has just been made at the Laibacher Moor, the well-known pile-dwelling ground. A peat digger found six silver coins of the size of a florin, which all bear the inscription of the Roman Emperor, Augustus Claudius. The discovery has been secured for scientific purposes.

THE Paris Academy of Arts has recently acquired an Egyptian papyrus which is particularly remarkable on account of its reputed age, which is estimated at over 4,000 years. It is perfectly preserved; its height is 8·30 metres, and its width 43 centimetres.

It contains a description of the death and the burial celebration of the mother of King Herod, from the first dynasty of Egyptian kings. The price paid by the Academy was 4,000 francs (160*l.*); the papyrus is now in the Exhibition.

IN the August number of the *Moniteur Scientifique* M. J. Laurent, of Marseilles, cautions the scientific world generally, and chemists in particular, against the use of de la Bastie's toughened glass. He considers the objects and utensils made of this substance to be no better than so many Prince Rupert's drops or Bologna flasks, from which they differ only by their shape. M. Laurent adduces an instance where a dish made of toughened glass was used at a stearine factory at Marseilles; it suddenly broke into thousands of fragments upon being placed on the metal scale of a balance. It was then in a state of cooling down from 110° C., at which temperature it had been maintained for some time; but it had previously been in use for about a month, and its sudden destruction was entirely inexplicable, save by the theory above mentioned.

WITH reference to Vesuvius the *Libertà* publishes the following letter from Prof. Palmieri, dated October 6:—"The phase of minor activity of the crater continues, nor is there sign of any speedy increase. Little smoke, very little lava, and a certain lesser activity in the eruptions of the new cone represent the phases of decreasing dynamism. According to some, I have announced augmenting force with the growth of the moon. I must state that I only said that if there was to be any increase, it would be verified towards the time of the full moon, according to the laws I have noted since Vesuvius has been my study, and confirmed by irrefutable documents from which I have drawn the history of our volcano. But, however it may be, this eruptive period, long foreseen, appears to require time to reach the evolution of the major phases it will ultimately attain." Telegrams from Naples on the 13th announced greatly increased activity in the volcanic action of Vesuvius.

MESSRS. MACMILLAN AND CO. have in preparation a text-book, systematic and practical, on the "Physiological Chemistry of Animal Bodies, and on the Changes which their Tissues and Fluids undergo in Disease," by Prof. Arthur Gamgee, M.D., F.R.S. The author seeks to fill up an important gap at present existing in English medical and scientific literature by preparing a succinct, though complete, account of the chemical processes of the organism, and of the methods of studying them. The work will primarily be a didactic and systematic treatise, and, though in no respect a servile imitation, will be constructedon the same plan as Prof. Kühne's most admirable, though now necessarily almost obsolete, "Lehrbuch der physiologischen Chemie:" Leipzig, 1866. It will differ, however, even in plan from that book, in containing elaborate descriptions of methods of research and directions for the performance of analyses, which will in part be introduced into the systematic portion of the text, and in part be added as appendices to each section. These appendices will be so detailed and complete as to render superfluous a separate laboratory treatise on Chemico-Physiological Analysis, such as the excellent books of Hoppe-Seyler, and Gorup-Besancy. It is the object of the author to prepare a work which will not only be useful to specialists in physiology, but to physicians, by whose researches the most important facts in the chemical history of the body have been discovered in the past, as they doubtless will be in the future.

FOUR shocks of earthquake were felt at Mineo, in Sicily, early on the morning of the 5th.

THE severe thunderstorms of October 7, 8, 9, 10, which raged in several parts of France with an almost unprecedented fury, were preceded by strong siroccos in Algeria, where the heat had been quite oppressive. The thunderstorms advanced in France from the south northwards, and even in the British Channel strong south gales were felt. The perturbation lasted during five days, when the magnificent weather which had marked the beginning of October returned.

THE large balloon, the *Crusader*, which escaped from the Royal Arsenal, Woolwich, on Monday afternoon last, descended in the Port Meadow, near Oxford, at 7 o'clock the same evening.

AN interesting account of the annual fungus foray of the Woolhope Club will be found in the *Gardeners' Chronicle* of October 12.

THE *Courrier de Bone* says that a singular phenemenon was observed at Clousel, in the vicinity of Hammam Mex Kontine, one of the most celebrated thermal bathing-places in Algiers. After an earthquake which took place in the beginning of September, an immense rock was precipitated from the mountain. Some inhabitants visiting the place found the opening of a grotto at the bottom of which a lake was discovered. The water is quite fresh and almost at zero Centigrade.

ACTIVE preparations are being made for the meeting of the Social Science Congress at Cheltenham on the 23rd instant.

CAPTAIN PATTERSON, Superintendent of the U.S. Coast Survey, has lately initiated a very important undertaking in connection with the work of the Survey, namely, in determining the extent and position of the oyster beds of the Chesapeake Bay, primarily with reference to the formation of oyster reefs, and their interference with navigation, but broad enough in its scope to serve as the basis of a critical investigation of the whole subject of the oyster fisheries and oyster culture in the United States. It is somewhat curious that the best article upon the statistics and distribution of the oyster in America is from the pen of Capt. Broca, a French officer sent over some years ago by his government to investigate this subject. The work is being prosecuted in the Chesapeake Bay by the Coast Survey steamer *Palinurus*, Mr. H. J. Rice, formerly of Johns Hopkins University, looking more particularly after the natural history features, such as the embryology and development of the oyster, &c. After the survey and investigation have been completed in Chesapeake Bay, the exploration will be extended to other points on the coast. For the better purpose of furnishing the required data for a critical investigation of the subject, the party, in addition to determining the depth of water in which the beds are situated, will secure samples of the water itself, with specimens of the oyster, and the temperature and currents will be observed, the whole work being conducted in accordance with the best principles of modern research.

M. THIERS' long-talked-of work on philosophy will soon be published; it is in the hands of copyists, who will finish their work this week. The work will include scientific subjects. It will be published in three volumes, but the first is the only one which has been completed. The last two volumes have not been revised by the author. M. Thiers began the work in 1864, after having received lessons in astronomy from Leverrier and in chemistry from Sainte Claire Deville. It was interrupted from 1870 to May 24, 1874, when Thiers was obliged to resign the presidentship of the French republic. But it underwent some interruption from January, 1877, when the illustrious author was appointed by the Chamber of Deputies President of the Commission for the Reorganisation of the Army. At St. Germain, when he suddenly died, he was busy re-writing his second volume.

MR. HORMUZD RASSAM, we learn from the *Times*, who returned to England in July last, bringing with him a rich collection of Assyrian antiquities, the result of his last expedition to explore the ruins of Ancient Nineveh, is about to start upon a second and much extended tour of exploration. The expeditions of the late George Smith and other explorers

during the last few years have been greatly impeded by the restricted nature of the firmans granted, and constant disputes were arising as to the area over which the firman extended. Mr. Rassam has succeeded in obtaining a series of sufficiently open permits to enable the new expedition to assume the nature of a roving exploring party. The new firman includes the whole of Mesopotamia, embracing the region around Mosul—that is, the sites of Nineveh, Kalakh, and the ancient city of Assur, the site of which is marked by the mounds of Kileh Shergat. A special firman has been obtained to enable Mr. Rassam to commence explorations in a hitherto untouched field—the districts of North-Eastern Syria. This region, the country which once formed the seat of the powerful Hittite kingdom, having for its capital the city of Carchemish, is as yet a *terra incognita* to explorers, and as its annals when discovered will form an important link in the chain of history which binds Assyria to the West, great results may be expected from Mr. Rassam's explorations in this district.

WE have on our table the following books:—"Pleasant Ways in Science," R. A. Proctor (Chatto and Windus); "Ancient History from the Monuments of Sinai," S. H. Palmer (S.P.C.K.); "Crystallography," H. P. Gurney (S.P.C.K.); "Bluthendiagramma," 1st and 2nd Parts, Dr. A. W. Eichler (Engelmann); "Studies from the Physiological Laboratory of University of Cambridge" (University Press).—London Science Class-Books (Longmans):—"Botany, Morphology, and Physiology," W. R. McNab; "Botany: Classification of Plants," W. R. McNab; "Hydrostatics and Pneumatics," P. Magnus; "Invertebrata and Vertebrata," Prof. Macalister; "Motion of the Moon," Dr. S. Newcomb (Washington); "Physical, Geological, and Geographical Map of Great Britain," Prof. Ramsay (Standford); "Meteorology of the Bombay Presidency," Charles Chambers; "Karl Ernst von Baer," Dr. Stieda; "Karl Friedrich Gauss, Hauptmann (E. J. Brill); "Report on Iron and Steel as Manufactured by Messrs. Jones and Laughlins," R. H. Thurston; "On the Equilibrium of Heterogeneous Substances," Parts 1 and 2, J. W. Gibbs; "Skizzen aus West Afrika," Oskar Lenz (A. Hofmann); "Les Produits de la Nature," A. J. C. Geertz (C. Lèvy); "La Prévision du Temps," W. de Fonvielle.

THE additions to the Zoological Society's Gardens during the past week include a Cross Fox (*Canis fulvus*) from Colorado, presented by Mr. Wilfred G. Marshall; a Common Otter (*Lutra vulgaris*), European, presented by Mr. W. H. Baylis; a Brown Mynah (*Acridotheres fuscus*), a Pied Mynah (*Sternopastor contra*) from India, an Indranee Owl (*Syrnium indranee*) from Ceylon, presented by Capt. J. Murray; four Egyptian Geese (*Chenalopex ægyptiaca*) from the Cape of Good Hope, presented by Mr. Justice Denyssen; two Leopard Tortoises (*Testudo pardalis*) from the Cape of Good Hope, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; a Collared Peccary (*Dicotyles tajaçu*) from South America, deposited; a Red-Sided Eclectus (*Eclectus polychlorus*) from Malacca, a Black-Footed Penguin (*Spheniscus demersus*) from the Cape of Good Hope, four Chinese Turtle-Doves (*Turtur chinensis*) from China, purchased; a Hybrid Mandrill Monkey (between *C. mormon* ♀ and *M. cynomolgus* ♂), an Indian Muntjac (*Cervulus muntjac*), born in the Gardens.

ON THE PRESENCE OF DARK LINES IN THE SOLAR SPECTRUM WHICH CORRESPOND CLOSELY TO THE LINES OF THE SPECTRUM OF OXYGEN[1]

THE measurement of the wave-lengths of the dark lines of the solar spectrum obtained by photographs, and the construction of a chart of the same, has for many years occupied my leisure time. As a result of the investigations connected with this work, I have arrived at the belief that oxygen as well as other non-metallic gaseous elements are represented in the solar spectrum by dark lines in the same manner as metallic substances. The lines in the case of oxygen are, however, very faint when compared with those produced by metals in the vaporous state.

The apparatus employed in these investigations may be briefly described as follows: 1st, a spectroscope for photographing the normal solar spectrum. As my purpose was to obtain photographs in which the positions of the lines should be as true as possible, I resorted entirely to the process by reflection, *and at no time did the solar rays pass through glass;* all error that might arise during refraction was thus avoided. The mirrors of the heliostat were of flat glass silvered, the silver-surface being polished served as the reflector. The surface of the concave-mirror employed to bring the image of the slit to a focus, was also silvered and polished. Gratings of 4,800 and 9,600 lines to the English inch, ruled on glass by a machine constructed by myself and by my assistant Mr. Sickels, and also an admirable one of 17,280 lines to the inch, for which I am indebted to Mr. Rutherfurd, were used. These were silvered with a thin coating, and the unpolished silver surface employed to give spectra by reflection. With the 4,800 line gratings the photographs were in the 1st and 3rd orders; with those of 9,600 lines in the 3rd order, and with 17,280 in the 1st and 2nd orders. The accuracy of the gratings was tested with satisfactory results by taking photographs in equivalent orders of spectra on each side of the normal. The photographs for the determination of the wave-lengths of the solar spectrum were in sections of eighty to one hundred and fifty wave-lengths. The gratings were adjusted to the line of no deviation for the centre of each section of the spectrum, as it was photographed.

The wave-lengths of the lines of the spectrum were carefully measured on the original photographs, by projecting them upon a scale of wave-lengths, each wave-length being five millimetres in extent. The scale was drawn upon slips of paper, which had been glued to strips of well-seasoned pine wood cut with the grain. The lantern used for projection was that described in this journal for April, 1878. The distance of the lantern from the scale, and the consequent magnifying power, was so adjusted as to make the leading lines of the photograph coincide with the same lines of Ångström, drawn in their proper position below the scale as is shown in the diagram given later on. Thus the positions of the lines in each section of one hundred or more wave-lengths were all made visible at once, and the errors in Ångström's chart corrected. From 4045 to 0 in the ultra-violet the leading lines of Cornu were employed. Among the advantages presented by this method of studying and measuring the lines of the spectrum we may mention the opportunity offered for several persons to inspect at the same time the details of the section under examination, and submit them to intelligent discussion. To this we may add the facilities offered for comparing many photographs with each other by marking below the scale the peculiarities of one, and then projecting the others in order upon the marks made. In this way the effects of duration of exposure and manner of development of the image, together with the variation in the size of the slit and focal distance may be investigated, and their action on the details of the picture determined. Pictures may even be placed face to face, one a little above the other, and examined in that position by projection. From the measures thus obtained a chart of the spectrum was constructed, which extended from E in the green to P in the ultra-violet. The values assigned to the wave-lengths in this chart are those of Ångström, and it is my purpose to present the positions and characters of certain of these lines in this communication.

The great increase in the number of lines in the chart made from photographs by Mr. Rutherfurd's grating, compared with that of Ångström, led me to collect all the measurements of spectrum lines of elements that I could find, for the purpose of determining the character of the newly-measured lines. On comparing the lines of the spectra of oxygen, nitrogen, and air, as given in Watt's index of spectra, from the researches of Thalén, Huggins, and Plücker, I was struck with the number of approximate coincidences between the wave-lengths of oxygen lines and those of dark lines in my map. Attempting to make a close comparison of the oxygen with the solar lines I was confronted by the following difficulties, viz.: the measurements

[1] By John Christopher Draper, M.D., LL.D., Professor of Natural History in the College of the City of New York. From the *American Journal* for October.